MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

BOP2024 – PRINCIPLES OF OPERATION RESEARCH

(All Sections/Groups)

5 March 2019
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE (5)** pages including cover page with **FOUR (4)** Questions only.
2. Attempt **ALL** the questions.
3. Please write all your answers in the Answer Booklet and Graph Paper provided.
4. The distribution of the marks for each question is given. Total marks 100.

QUESTION 1 (25 MARKS)

a) As part of a quality improvement initiative, Smart Electronics employees complete a three-day training program on teaming and a two-day training program on problem solving. The manager of quality improvement has requested that at least 8 training programs on teaming and at least 10 training programs on problem solving be offered during the next six months. In addition, senior-level management has specified that at least 25 training programs must be offered during this period. Smart Electronics uses a consultant to teach the training programs. During the next quarter, the consultant has 84 days of training time available. Each training program on teaming costs $10,000 and each training program on problem solving costs $8000.

i) Formulate a linear programming model that can be used to determine the number of training programs on teaming and the number of training programs on problem solving that should be offered in order to minimize total cost. (7 marks)

ii) Sketch the feasible region (5 marks)

iii) Compute the optimum solution and total cost that minimize. (3 marks)

b) A PhD holder is considering working one of the following four universities. Nine criterions and its weights are shown. Determine the recommended choice.

Criteria	Weight	Ratings			
		Y University	M University	S University	N University
University prestige	1	4	7	5	8
Working hours	5	7	6	4	6
Salary	5	3	6	6	10
Distance from home	2	7	8	8	2
Allowance & benefits	3	5	7	7	7
Career advancement	4	3	9	6	9
Enjoyable	3	6	4	4	5
Research opportunities	5	4	8	6	8
Adminstrative workload	5	1	7	5	7

(10 marks)

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QUESTION 2 (25 MARKS)

a) Mama Foods Manufacturing Sdn Bhd (MFM) just introduced a new banana instant noodles. As part of its promotional campaign, the marketing department decided to send personalized invitations to be taste testers to two target groups: (1) TV and celebrity chefs and (2) big hotels and restaurants chefs. The cost of sending a personalized invitation to each potential taste testers is estimated to be $1 per letter. Based on previous experience, MFM estimates that 25% of the potential taste testers contacted from group 1 and 10% of the potential taste testers contacted from group 2 will become the taste testers of this new instant noodles. As part of this initiative, MFM set the following goals.

Goal 1: Get at least 100 potential taste testers from group 1 to be the taste testers.
Goal 2: Get at least 50 potential taste testers from group 2 to be the taste testers.
Goal 3: Limit the expense of sending out invitations to $700.

Assume that goal 1 and 2 are P_1 priority level goals and that goal 3 is a P_2 priority level goal. Suppose that goal 1 and 2 are equally important; formulate a goal programming model of the MFM problem.

(12 marks)

b) Nana and Associates Sdn Bhd is an accounting firm that has three new clients (Ali, Meng and Muthu). Project leaders will be assigned to the three clients. Based on the different backgrounds and experiences of the leaders, the various leader-client assignments differ in terms of projected completion times. The possible assignments and the estimated completion times in days are as follows:

	Clients		
Project Leader	**Ali**	**Meng**	**Muthu**
Lily	10	16	32
Mimi	14	22	40
Lala	22	24	34

Construct a new network representation of this problem.

(13 marks)

QUESTION 3 (25 MARKS)

a) Give and explain any **THREE (3)** characteristics of a queuing system.

(9 marks)

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b) The distribution system for the Hugo Company consists of three plants (1, 2 and 3), two warehouses (Hehe and Haha) and four customers. Plant capacities and shipping costs per unit (in $) from each plant to each warehouse are as follows:

	Warehouse		
Plant	**Hehe**	**Haha**	**Capacity**
1	4	7	450
2	8	5	600
3	5	6	380

Customer demand and shipping costs per unit (in $) from each warehouse to each customer are as follows:

i) Present a network representation of this problem. (13 marks)

ii) Suppose that shipments between the two warehouses are permitted at $2 per unit and that direct shipments can be made from Plant 3 to Customer 4 at a cost of $7 per unit. Show the differences on the same network representation that you have developed at question (i) of this problem. (3 marks)

QUESTION 4 (25 MARKS)

a) Fresh Air Conditioning Sdn Bhd produces three home air conditioners, an economy model, a standard model and a deluxe model. The profits per unit are RM63, RM95 and RM135, respectively. The production requirements per unit are as follows:

	Number of Fans	Number of Cooling Coils	Manufacturing Time (hours)
Economy (E)	1	1	8
Standard (S)	1	2	12
Deluxe (D)	1	4	14

The linear programming model for the problem is as follows:

Max $63E + 95S + 135D$

s.t.

$1E + 1S + 1D \leq 200$ Fan motors

$1E + 2S + 4D \leq 320$ Cooling coils

$8E + 12S + 14D \leq 2400$ Manufacturing time

$E, S, D \geq 0$

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The computer solution (Spreadsheet 1) showed the following information:

SPREADSHEET 1

Optimal Objective Value = 16440.00000

Variable	Value	Reduced Cost
E	80.00000	0.00000
S	120.00000	0.00000
D	0.00000	-24.00000

Constraint	Slack/Surplus	Dual Price
1	0.00000	31.00000
2	0.00000	32.00000
3	320.00000	0.00000

Variable	Objective Coefficient	Allowable Increase	Allowable Decrease
E	63.00000	12.00000	15.50000
S	95.00000	31.00000	8.00000
D	135.00000	24.00000	Infinite

Constraint	RHS Value	Allowable Increase	Allowable Decrease
1	200.00000	80.00000	40.00000
2	320.00000	80.00000	120.00000
3	2400.00000	Infinite	320.00000

i) State the optimum solution and the value of the objective function. (4 marks)

ii) State the binding constraints. (2 marks)

iii) Which constraints show excess capacity? How much in excess? (2 marks)

iv) If the profit for the deluxe model were increased to RM150 per unit, would the optimal solution change? Use the information from **SPREADSHEET 1** to answer this question. (2 marks)

v) If the profit for the economy model is increased by RM6 per unit, the profit for the standard model is decreased by RM2 per unit and the profit for the deluxe model is increased by RM4 per unit. Would the optimal solution change? Explain. (5 marks)

vi) If the number of fan motors available for production is increased by 100, will the dual price for that constraint change? Explain. (2 marks)

b) Describe any **TWO (2)** advantages and **TWO (2)** disadvantages of simulation. (8 marks)

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